

**BIOLOGICAL EVALUATION FOR BIGHORN SHEEP  
LIVESTOCK GRAZING AND VEGETATION MANAGEMENT ON 5  
PROJECT AREAS - FEIS**

**AND**

**SUPPLEMENT TO THE FOREST PLAN  
BIOLOGICAL EVALUATION**

**Bighorn National Forest  
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# **I. INTRODUCTION, GOALS AND OBJECTIVES**

## **1. INTRODUCTION**

Rocky Mountain bighorn sheep are a premier wildlife species in Wyoming because of their high economic value for wildlife viewing and hunting opportunities. They are also a species of increasing conservation concern, particularly due to a heightened recognition of a potential for disease related mortality of bighorn sheep, likely in association with contact from domestic sheep.

This analysis compiles the existing information on bighorn sheep on the Forest relative to management direction in the Forest Plan, incorporates a risk assessment conducted for potential bighorn/domestic sheep contact, and also provides the required analysis at the project scale for the Livestock Grazing and Vegetation Management on 5 Project Areas FEIS. It provides decision makers with information associated with continued management for this species relative to the management of viable animal populations as per the 1982 Planning Rule (36 CFR 219.19), under which the Forest Plan was written, and the species diversity requirement of the National Forest Management Act.

Bighorn sheep were split out of the BE prepared for all other sensitive wildlife species in the Big 6 FEIS, due to the additional analysis required for the potential contact with domestic sheep. This was a change that occurred between the Draft and Final EIS for this project. In particular, a Risk Assessment of Potential Contact between domestic and bighorn sheep was developed between the Draft and Final EIS, that is applicable to both the project and forest-wide scale, and is incorporated by reference into this BE.

The BE for other wildlife species is contained in the project record. In addition to wildlife species, BEs were also prepared for sensitive plant and aquatic species, as documented in the project record.

It is Forest Service policy to ensure that authorized actions do not contribute to a loss of viability of threatened, endangered, proposed, or sensitive plant and animal species, or contribute to a trend towards federal listing under the Endangered Species Act of any species (USDA Forest Service 2009a). A BE is a documented Forest Service review in sufficient detail to provide information to assist decision makers in achieving this goal.

Several literature sources were considered in this analysis as “best available science”, which were not addressed in previous analyses. One key literature source involves a regional bighorn sheep species conservation assessment (Beecham et al. 2007) that was published in support of the Forest Service Region 2 Species Conservation Project. The regional species conservation assessment provides the foundation for much of the information and framework of this analysis. Additional key literature sources include WAFWA domestic/bighorn interaction recommendations (WAFWA 2010), USFS domestic/bighorn interaction recommendations (Schommer and Woolever 2001), the Wyoming statewide bighorn/domestic sheep working group recommendations (WGFD

2004), the GIS based evaluation of potential bighorn sheep habitat for the Bighorn NF (Hughes 1997), the Devils' Canyon Bighorn Sheep Supplemental Transplant and Resource Selection Analysis (WGFD 2009a) and the WGFD Job Completion Report that contains herd management goals (WGFD 2009b). This analysis also recognizes the ongoing controversy regarding the disease transmission issue, the evolving nature of the science associated with the issue, and incorporates alternative views as applicable (CAST Commentary 2008). Best available science was also considered in the development of the design criteria and the risk modeling process as described in the Risk Assessment.

This BE was patterned after a similar BE prepared on the Rio Grande National Forest (USFS 2010a) that considered updated information to the Forest Plan BE.

## **2. OBJECTIVES**

The objective of this analysis is to update the Forest Plan BE in sufficient detail to determine whether the direct, indirect, or cumulative effects associated with the selected alternative (FEIS Alternative D) or other alternatives would contribute toward federal listing or loss of viability for bighorn sheep within the planning area that comprises the Bighorn National Forest (NF).

The analysis will similarly assess the effects associated with the three alternatives being considered with the Big 6 project. Adjacent lands to the Forest are included as necessary due to cumulative effects on and off the Forest on bighorn sheep considered. This analysis does not affect the planning decisions of agencies other than the Bighorn NF. Utilization of information regarding other land ownerships aids in determining landscape-scale potentials for conflict that may contribute to the viability of bighorn sheep.

## **II. MANAGEMENT STATUS AND NATURAL HISTORY**

### **1. MANAGEMENT STATUS**

Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) are currently found in all western states and provinces with historical records, from New Mexico to British Columbia. However, northern races or subspecies of bighorn sheep (*O. c. canadensis*, *O. c. californiana*, *O. c. auduboni*) were extirpated from Arizona, New Mexico, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Utah, and Washington (Toweill and Geist 1999). The states of California and Oregon lost an estimated 110 populations (McQuivey 1978, Wehausen et al. 1987). Populations in other western states and provinces of the United States and Canada probably declined to fewer than 5,000 individuals (Toweill and Geist 1999).

The current distribution of Rocky Mountain bighorn sheep is primarily patchy and fragmented throughout much of their historical range. In 1999, the total numbers of all bighorn sheep (Rocky Mountain and desert subspecies) in the contiguous United States were estimated at approximately 49,900 (Toweill and Geist 1999). Most extant populations of bighorn sheep in the Intermountain West consist of less than 100

individuals occurring in a fragmented distribution across the landscape (Singer et al. 2000a). Many of these herds are considered vulnerable to extirpation because of their small numbers and the lack of connectivity between herds (Wehausen 1999 and others *in* Beecham et al. 2007). Due to potential disease concerns, however, connectivity may currently not be desirable in all locations (CAST Commentary 2008).

Bighorn sheep numbers declined dramatically with the settling of the west and are currently estimated at less than 10 percent of historic numbers. However, they are still considered secure throughout much of their range (NatureServe 2010), and are listed as a G4 species. Beecham et al. (2007), however, argue that these classifications may be overly-optimistic because they fail to recognize the critical issues involved with small herd sizes, the long history of and continued potential for disease epizootics, increasing levels of habitat fragmentation, and herd/genetic isolation.

Considering the information above, the Rocky Mountain Region of the Forest Service, which provides the most habitat and largest populations of this species in its range, listed this species as sensitive.

#### Big Horn Mountains and Bighorn National Forest

It is difficult to estimate how many bighorn sheep were present in Wyoming in pre-European settlement times. They were native to the Bighorn National Forest and surrounding plains (Buechner 1960). Through census information compiled by early Forest Rangers (USFS 1914), their numbers remained at less than 200 through the 1920s, before reducing even further.

Towns (1899) estimated 400,000 domestic sheep on the Forest and 3,000 cattle on northern ¼ of the Forest. Murray (1980) described a range of cattle and horse numbers from 30,000 to 36,000, and domestic sheep from 110,000 up to 118,000 per year on the Forest between 1906 and 1916. It is not known if disease from the domestic sheep caused the early die-offs of bighorns, however competition for range forage would likely have been a factor. Predators were aggressively controlled in association with livestock grazing in these early years, which would have reduced predation on bighorn sheep, although unregulated hunting in the early years was also likely a significant mortality factor for bighorns. While the effects on bighorn sheep from livestock are speculative, it can be presumed that they were much greater historically than the 22,000 cattle and 14,000 sheep permitted for shorter seasons in 2010.

Bighorn sheep were first reintroduced into the Big Horn mountains beginning in the early 1930's, and reintroduction efforts have continued since by the Wyoming Game and Fish Department (WGFD 1998). The remaining two populations on and adjacent to the Forest from those efforts are described in the Risk Assessment as the Devils Canyon and Shell Canyon populations. The Risk Assessment contains information on the status of these populations, based on recent telemetry studies. In addition, a third population is considered in the Risk Assessment, described as the Bighorn Canyon National Recreation Area herd, which is not currently known to occur on the Forest at all, though it may

interact with the Devils Canyon herd. Refer to the population viability section below for a summary of each herd's status.

## **2. NATURAL HISTORY**

Rocky Mountain bighorn sheep are ungulates native to North America in the family Bovidae. Bighorn sheep are characterized by low reproductive rates, long life spans, and populations adapted to live near carrying capacity in relatively stable environments (Geist 1971).

Bighorn sheep are a sexually dimorphic species with ewes that may weigh 190 pounds and rams may weigh greater than 300 pounds. Large-horned, older rams do much of the breeding, though younger rams will breed opportunistically (Hogg and Forbes 1997). Rams may breed several ewes; however, they are not territorial nor do they form harems, but rather are serial polygynists. Ewes generally first breed at 2.5 years and give birth to one lamb after a gestation period of 180 days (Lawson and Johnson 1983). In populations with high-quality forage, ewes may breed at 1.5 years and give birth at the age of two. Although twins have been documented in both wild and captive bighorn sheep it occurs infrequently (Eccles and Shackleton 1979).

In the Rocky Mountains, bighorn sheep generally breed from late October through late December with the peak breeding season occurring from about mid-November to mid-December (Beecham et al. 2007). Most lambs are born from late April through early June, with few lambs born after mid-June. Lambs borne early in the breeding season (May-early June) have a much higher likelihood of surviving later into the season than those borne after mid-June. Bighorn sheep generally have a life span of 10-14 years, although exceptions as old as 18 years have been reported (Geist 1971, Goldstein 2001). Mortality tends to be high the first year, low from ages 2-8, and then increases after age nine (Lawson and Johnson 1983).

Bighorn sheep are social animals that live in groups most of the year. Ewe groups (comprised of adult ewes, yearling ewes, lambs, and young rams) generally are larger than ram groups especially during late spring and early summer when nursery bands may contain 25-100 animals (Lange 1978, NMDGF files). Mature rams generally remain solitary or in bachelor groups except during the pre-rut and rut periods (November-January), when rams and ewes gather on the same range.

Bighorn sheep eat a wide variety of plants and their diets vary seasonally and throughout their geographic range (Todd 1975, Cooperrider and Hansen 1982, Johnson 1980, Rominger et al. 1988). Succulent vegetation in summer and snow and ice in winter help bighorns to survive for long periods without freestanding water. Forbs generally dominate the diet, followed by grasses, and lastly browse (Krausman and Shackleton 2000). However, some low-elevation Rocky Mountain bighorn sheep populations have diets dominated by the leaves of browse species, particularly true mountain-mahogany (Rominger et al. 1988). Bighorn sheep also use mineral licks, especially during summer when green, potassium-rich forage is consumed (Weeks and Kirkpatrick 1976).

Unlike other ungulates in which young disperse to new areas, bighorn sheep pass knowledge of home ranges and migration routes from one generation to the next. Therefore, bighorn sheep do not typically re-colonize ranges where they have been extirpated. Translocations are generally required to establish new populations (Singer and Gudorf 1999).

### **3. HABITAT RELATIONSHIPS**

Bighorns typically occur in steep, high mountain terrain. They prefer high visibility habitat dominated by grass, low shrubs, rock cover and areas near open escape terrain. They often retreat to rest on inaccessible cliffs. Many bands now spend all year near timberline on what used to be their traditional summer range (George et al. 2009).

Climate, elevation, and latitude influence the vegetative structure and composition in bighorn sheep habitat. Within individual home ranges, different habitats meet the specific requirements of wild sheep, including foraging, resting, mating, lambing, thermal cover, and predator avoidance (Hansen 1982, Risenhoover and Bailey 1985, Dale 1987). Seasonal use of different slopes and aspects results in a mosaic of plant communities and phenological patterns which provide foraging and security opportunities for bighorn sheep (Valdez and Krausman 1999).

Warm temperatures on south-facing slopes result in earlier green-up, marking the transition from winter range to spring range. During the spring green-up, mineral licks appear to be an important component of bighorn sheep habitats where soils are derived from granitic materials. As temperatures continue to rise during late spring and early summer, bighorn sheep make greater use of north, east, and west-facing slopes at higher elevations for foraging (McCullough and Schneegas 1966, Goodson 1978). Alpine meadows and high elevation plateaus are important summer foraging areas for many Rocky Mountain sheep populations (Blood 1961, Sugden 1961, Pallister 1974, Shannon et al. 1975). The elevation and aspect preferred by bighorn sheep varies according to forage succulence and ambient temperature.

While bighorns feed in open areas, they are rarely found more than 0.25 miles (400 m) from escape cover, where they have an advantage over most predators (Oldemeyer et al. 1971, Erickson 1972, Pallister 1974, Krausman and Leopold 1986, Krausman and Bowyer 2003). Bighorn sheep rely on keen vision to detect predators, and on rapid mobility on steep terrain as the principal means of avoiding predators (Geist 1971). Thus, open, steep terrain is the defining component of bighorn sheep habitat (McQuivey 1978, Risenhoover et al. 1988, Krausman and Shackleton 2000). Talus slopes, rock outcrops, and cliffs provide habitat for resting, lambing, and escape cover (Erickson 1972, Kornet 1978, Van Dyke 1978). Adult male sheep are known to move farther away from security cover than females, presumably because of a combination of factors including exclusion from some habitats by adult ewes and lambs, selection for optimal forage to maximize their growth rate, and greater ability to defend themselves from predators (Shank 1979, Hansen 1982). Young rams in particular have a propensity to wander great distances

from escape cover, particularly during the breeding season (Schommer and Woolever 2001).

Escape terrain is critical for ewes during lambing (Blood 1961, Kornet 1978, Hall 1981), to the extent that they will sacrifice access to high quality forage for security (Cook 1990, Bleich et al. 1997). Both ewes and lambs are vulnerable to predation immediately prior to and for one to two days after parturition. Shackleton et al. (1999) suggested that bighorn lambing habitat served three primary functions: 1) escape cover from predators, 2) a favorable microsite that afforded lambs protection from bad weather, and 3) a secure, secluded area where the ewe and lamb could cement the mother/young bond. Adult female bighorns exhibit strong fidelity to parturition sites and often use the same lambing grounds year after year. In the Rocky Mountains, lambing areas are usually on or very close to wintering areas (Geist 1971).

Key elements of winter ranges for bighorn sheep include low snow depth and wind-swept areas with sufficient forage and adjacent escape terrain for eluding predators (Krausman and Bowyer 2003). Wind, cold temperatures, and heavy snow accumulation are likely limiting factors for Rocky Mountain bighorn sheep in some areas. Stelfox (1975) suggested that the critical snow depth for Rocky Mountain bighorn lambs was 12-17 inches (30 to 44 cm), 13-19 inches (32 to 48 cm) for yearlings and adult females, and 14-21 inches (36 to 54 cm) for adult males. Consequently, most bighorn winter ranges occur on steep south, southwest, or southeast-facing slopes where maximum heat gain reduces cold stress and snow cover, and increases the availability of forage (Smith 1954, Blood 1961, McCullough and Schneegas 1966, Morgan 1970, Geist 1971, Riggs 1977, Krausman and Bowyer 2003). In some areas, bighorn sheep may remain at or move to high elevation, wind-swept ridges to avoid heavy snow depths at lower elevations (Nichols and Erickson 1969, Geist 1971, Geist and Petocz 1977). Snow quality (Sugden 1961) and the proximity of security cover (Wishart 1958, Shannon et al. 1975) are other factors influencing sheep use of winter ranges.

**b) Local Habitat Information:** The overall components of bighorn sheep range include summer, winter, and concentration areas as well as migration routes. All of these components are found in the Big Horn mountain range.

Local habitat relationships for bighorn sheep are similar to those described above. However, the Devils Canyon herd was augmented with individuals from populations that did not exhibit large migratory seasonal or elevational movements for habitat selection. Thus, this population has largely remained in the transplant area, with some wandering occurring. The Shell Canyon population, while showing more elevational movement than the Devils Canyon herd, remains most of the time in the Shell Canyon watershed on the Forest, primarily at lower elevations, with some travel to higher summer range areas in the watershed.



### III. CONSERVATION

#### 1. THREATS AND LIMITING FACTORS

There are several threats mentioned in the literature that function as limiting factors on most bighorn populations. However, the common theme throughout the western United States including Wyoming is the significance that infectious diseases can and have had on population performance and species abundance. The primary immediate threats to bighorn sheep as mentioned for Forest Service Region 2 (Beecham et al. (2007) are discussed below. The applicability of these threats to individual bighorn herds on the Bighorn NF is included in each section below.

##### **a. Disease Epizootics**

Of diseases, the primary disease of concern is pasteurellosis caused by infections with bacteria presently classified in the genera *Pasteurella*, *Mannheimia*, and *Bibersteinia*. In this document, the term pasteurellosis or *Pasteurella* is also referred to as respiratory disease and pneumonia because they are often used interchangeably. These infections can sometimes be exacerbated by other bacteria, viruses, or parasites (e.g. pink eye). In addition to initial all-age die offs, pasteurellosis epidemics in bighorn sheep can cause long-term reductions in lamb survival and recruitment resulting in stagnant or declining populations over many years (George et al. 2009). Interactions between wild sheep and domestic goats, not as widely reported, seem to pose comparable risks (Jansen et al. 2006).

Research shows that contact between bighorn and domestic sheep can lead to respiratory disease and fatal pneumonia in bighorn sheep (CAST Commentary 2008). As of 1996, there were over 30 documented cases of bighorn die-offs after their association with domestic sheep (Martin et al. 1996 in Beecham et al. 2007). However, not all pasteurellosis epidemics in bighorn sheep can be attributed to contact with domestic sheep and die-offs have occurred with no documented contact between the two species (Wyoming Statewide Bighorn/Domestic Sheep Interaction Working Group 2004, CAST Commentary 2008). For example, some potentially pathogenic *Pasteurella* strains and other pathogens are endemic in some wild sheep populations and may be transmitted amongst the bighorn sheep herds themselves (CAST Commentary 2008). Empirical studies and field observations demonstrate that interactions between domestic and bighorn sheep increase the probability of mortality and subsequent reduced lamb survival in bighorn populations, primarily because of respiratory illness. However, potential contact between domestic and bighorn sheep cannot be attributed to all disease epidemics (CAST Commentary 2008).

The transmission of pneumonia from domestic sheep to bighorns requires very close contact (less than 60 feet) or transfer of mucus through coughing and sneezing (Dixon et al. 2002). Because bighorns are behaviorally attracted to domestic sheep, preventing contact between the species can be challenging when they occupy the same range during the same time period (Schommer and Woolever 2001). However, the contact/potential

disease transmission issue is unique in that it may only take one contact by one domestic sheep to spread respiratory illness throughout and between bighorn sheep herds.

There are numerous other diseases of concern to bighorn sheep populations; however, most of these are not fatal or known to cause the all-age die offs that occur with pasteurellosis. Although these diseases are not considered a major threat to bighorn populations, they have been implicated in predisposing bighorns to *Pasteurella* outbreaks (Beecham et al. 2007, CAST Commentary 2008). The overall importance of these pathogens to the health of bighorn sheep herds is not clearly understood at this time but may have implications to the overall health of some bighorn sheep herds (CAST Commentary 2008).

Due to the potential for disease transmission, the Payette National Forest in Idaho recently completed a Forest Plan amendment to incorporate management direction to minimize any potential contact (USFS 2010b). Accompanying this management effort, the Forest Service Intermountain Region and the Washington Office also released briefing papers informing Forests of this issue, including recommended strategies for analysis and management of the issue (USFS 2010c, d).

#### Wyoming Game and Fish Department Disease Management Actions

With the identification of the disease transmission issue, the Wyoming Game and Fish Department and interested agencies, industry representatives, and individuals formed the Wyoming State-wide Bighorn/Domestic Sheep Interaction Working Group beginning in 2000. In 2004, this group developed a Final Report and Recommendations to assist interested parties in managing sheep grazing and bighorn sheep populations to minimize potential disease transmission (WGFD 2004). While the Forest Service has remained a participating member of this group, the agency did not sign the Report due to wording that recommended no net loss of domestic sheep that could be perceived as precluding the agency from taking management actions related to other resource or permit concerns.

One aspect of the Report was to identify “core, native herds” within the State that would become the management priority for all parties involved. Other categories for bighorn sheep herds and potential habitat areas included “cooperative review”, “non emphasis”, and “non-management” areas. Through this approach, the State was interested in protecting the viability of existing high priority herds, and maintaining opportunities to establish or enhance herds in other areas, while continuing to provide opportunities for domestic sheep grazing. The Devils Canyon herd was classified by the State as a “cooperative review” area, while the Bighorn National Forest, including the Shell Canyon herd, was classified a “non-emphasis” area. These designations were not developed to preclude other management responsibilities or opportunities that any landowner or entity may be legally required to provide, nor did the Forest Service ask for any certain management area designations through this effort. The Bighorn National Forest, in 2002, accepted a domestic sheep permittee from the Shoshone NF that was transferred in part to enhance the habitat potential for the core, native bighorn herd on the

Shoshone. This permittee was transferred to vacant domestic sheep allotments that are now being considered within the Big 6 project analysis.

Another aspect of Wyoming State management efforts to minimize disease transmission is to issue a policy on handling the comingling of bighorn sheep and domestic sheep/goats (WGFD 2006). This policy states that bighorn sheep known to be in contact with domestics would either be live captured and transferred to the Sybille research center, or lethally removed. If stray domestic sheep are known to come into contact, the owner will be contacted and asked to remove the stray sheep/goat.

Further, the WGFD has obtained ewe/lamb license issuing authority to issue permits to hunters on short notice to remove female wandering bighorn sheep. This may be employed in the Shell or Devils Canyon herd, as indicated by WGFD, to prevent these two herds from contacting each other. Finally, the WGFD also live trapped several bighorn sheep in 2010 from the Devils Canyon herd that were showing a tendency to wander south of Cottonwood Canyon, that could have potential to keep wandering and come into contact with the Shell Canyon herd. Cottonwood Canyon, that is north of Hwy 14A, has been identified by the WGFD as a management threshold area to limit the southern expansion of this herd, in order to prevent contact with Shell Canyon sheep and potentially domestic sheep (Hurley pers. comm. 2010; Easterly 2011).

In addition to the WGFD policy on managing to prevent comingling of bighorn and domestic sheep, the domestic sheep industry in Wyoming is also regulated by state statute to remove diseased (Wyoming Statute Title 11 Chapter 19) and stray (Wyoming Statute Title 11 Chapter 24) domestic sheep.

#### Disease Status of Shell Canyon, Devils Canyon, and Bighorn Canyon Herds

From the 111 bighorns reintroduced to Shell Canyon, there was likely contact with domestic sheep both on and off the Forest. Bighorns were seen as far west as the town of Shell, WY likely interacting with domestic sheep there, and have been reported to be observed with domestic sheep on the Forest (T.Easterly, pers. comm.). The reintroduction was conducted at a time when this potential for disease transmission was not well understood, and sheep used in the transplant may also have arrived with diseases. There remains a domestic sheep herd within one mile of the Forest boundary near Shell, WY, that is not associated with any domestic sheep permitted to graze on the Forest, but is within an easy travel distance for bighorn sheep. The die-off of the Shell Canyon herd is not documented to be attributed to disease, and other factors including predation may have been significant. Although it is unknown if the Shell Canyon herd is currently infected or a carrier of disease, it is regarded as such from a management standpoint due to known past contact with domestic sheep, and from possible arrival with infection. As described in the Risk Assessment, another factor with this Shell Canyon herd is the desire to maintain its isolation from the Devils Canyon herd due to potential disease transmission to that herd (Easterly, 2011). However, since this herd has persisted, there could also be some future management benefit if they have developed a possible resistance to disease.

The Devils Canyon and Bighorn Canyon NRA herds are currently considered to be healthy, and viable in numbers, with no known instances of disease. There has been one instance of a stray domestic sheep within the Bighorn Canyon NRA within the past 5 years, though no domestic sheep grazing is permitted there, and no contact with bighorn sheep were noted from this stray. There are not known to be any domestic sheep in Montana to the north of either herd that could interact with them. There is one domestic goat flock near the Bighorn Canyon herd that could be a source of disease transmission, as displayed in the Risk Assessment. There was a domestic goat herd being used in the Yellowtail Habitat Management Area for weed control, south of the NRA, that has since been moved further from the bighorn herds by the WGFD, and may not be used any more in the future.

#### **b. Herd Size and Loss of Genetic Diversity**

In pre-settlement times, it is likely that most of Wyoming's bighorn populations existed as large metapopulations that could have encompassed several current herds. Bighorn sheep within these metapopulations would have interacted over large areas and maintained high genetic diversity. It is also likely that the historic metapopulation structure would have promoted greater movement of bighorn sheep between summer and winter ranges and other suitable habitat. It is also hypothesized that disease transmission from domestic sheep caused the widespread reductions in populations from pre-settlement times. Currently, large-scale movements and herd interactions have been greatly restricted because most extant populations occur as small, isolated herds separated by landscape habitat fragmentation factors such as roads, towns, urban home-sites, and other human developments. In some cases, vegetation changes due to fire suppression have also contributed to herd restrictions. Because of these factors, the potential loss of genetic variability in many remaining herds may be of concern. Conversely, however, restoring connectivity could increase the risk of introducing and spreading infectious diseases, which could negate any potential benefits from increased connectivity.

Both the Shell Canyon and Devils Canyon herds are of concern for overall herd size in relation to recovering from potential perturbations, but Shell Canyon has the least likelihood for continued survival with 10 to 20 animals. There may also be some genetic exchange between the Devils Canyon and Bighorn Canyon herds, particularly as animals may cross river ice. Finally, while the Devils Canyon herd is not a core native herd, it does possess genetic diversity from the standpoint that the population has been augmented from at least three different sources of bighorn sheep.

#### **c. Habitat Quality and Quantity**

The carrying capacity of available habitat will ultimately limit any bighorn population that is not otherwise limited by other factors. The Hughes et al (1997) thesis prepared for the Big Horn Mountains indicated habitat potential for a minimum viable population of 125 up to 1,530 bighorns. However, juxtaposition of lambing habitat was of question, and the potential disease transmission from domestic sheep was of question.

A vegetation map provided in the Risk Assessment documents potential barriers to bighorn sheep movement from timber stands, but also shows the widespread availability of shrub and grass vegetation types near the steep canyon faces along the perimeter of the Forest. Timber cover on the Bighorn Forest is largely tied to soil types, and as such there are few areas that have been significantly affected by conifer encroachment tied to fire suppression efforts in the past century. With bighorn sheep being widespread during pre-European settlement times, it is estimated that the non-forested portions of the Forest are potential habitat for the species, with the best potential habitat near any steeper, rocky canyons, particularly near the boundaries of the Forest, or higher in the Cloud Peak wilderness.

With regard to the Devils Canyon herd, the WGFD and BLM have conducted habitat improvement projects including additional water sources and prescribed burns to improve the habitat for that herd. Similarly, the Park Service has conducted prescribed burns to improve habitat for the Bighorn Canyon herd. The Forest Service throughout the late 1990's through 2005 was conducting prescribed burns in Shell Canyon in part to benefit that herd, and the Bone Creek fire of 2007 may have created additional travel corridors and habitat for bighorns.

#### **d. Human Disturbance, Development and Habitat Fragmentation**

Bighorn sheep have habituated to human activity in many areas where the activity is somewhat predictable. In Forest Service Region 2, the primary concern for human-related disturbances occurs on winter ranges (Beecham et al. 2007). Winter ranges usually encompass or are close to traditional lambing areas, which are also susceptible to disturbance (Bailey and Cooperrider 1982). Human disturbances can alter the movement patterns of individual bighorn sheep and cause them to wander into high-risk areas that may have not otherwise occurred, and may impact lambing area survival (Beecham et al. 2007).

There is little doubt that habitat loss and fragmentation by roads, recreation areas, residential developments, domestic sheep allotments, and other factors has had and will continue to have major impacts on Rocky Mountain bighorn sheep populations (George et al. 2009). Many of these factors also influence the ability to manage for metapopulations.

Locally, Highways 14 and 14A bisect habitat, and Highway 16 on the south end of the Forest could impact potential bighorn sheep habitat there. There are also hiking trails in Shell Canyon leading into the wilderness that may impact bighorn sheep habitat use there, as well as other roads and cabins in the Shell Canyon area. There are also roads and hiking trails on the north end of the Forest that could potentially encourage human interaction with the Devils Canyon herd. Refer to maps in the Risk Assessment to view the highways in relation to herd locations. Highways, other roads, or recreation uses are not currently known to be negatively impacting bighorn herds.

#### **e. Competition**

Competition with domestic and wild ungulates can potentially influence bighorn sheep. From a forage perspective, bighorn sheep have the most dietary overlap with domestic sheep, cattle, and elk and less overlap with species such as mule deer. Researchers have reported that cattle were serious dietary competitors with bighorn where their habitats overlapped, and also compete through spatial displacement (several authors *in* Beecham et al. 2007). The impact on bighorns due to an apparent social intolerance of cattle has resulted in displacement from traditional range areas and disruption of the lamb-rearing season (Taylor 2001, Beecham et al. 2007). Potential competition between bighorns and livestock is especially critical during periods of the year when forage is limited or of low quality (Bavin 1975 *in* Beecham et al. 2007).

Regarding native ungulates, potential competition with elk is the primary concern. Elk can have greater negative effects on bighorn sheep because they are much larger, have a broader dietary overlap with bighorn sheep than other wild ungulates, and can gather in large herds on traditional bighorn habitat summer range in the alpine zone (George et al. 2009).

Locally, it is not currently known that any competition from domestic or wild ungulates are restricting bighorn sheep habitat use from a forage availability perspective on the Bighorn Forest or in the mountain range as a whole. There are many active cattle grazing allotments and high numbers (at or above objective) of wild ungulates throughout the area that may be considered cumulative effects to bighorn sheep populations. Elk currently migrate primarily to the north of the Forest into Montana for winter range, and have not been known to use summer range in high numbers near the Devils Canyon herd. An elk herd resides in Shell Canyon, at approximately 200 animals. Cattle allotments are grazed under rotational rest or deferment systems, providing opportunities for movement of wildlife around the cattle grazing. As stated above, potential competition for forage with domestic livestock now is far less than has historically occurred.

#### **f. Harvest**

While unregulated harvest in past history likely played a significant role in population declines in the state, it is not currently a concern with Wyoming bighorn sheep populations.

Locally, there was never any hunting allowed on the Shell Canyon bighorn herd prior to its decline, nor is there currently. On the Devils Canyon herd, only one to two ram licenses have been issued each year over the past few years, which is near 1% of the population, well within sustainable limits. Poaching has been known or suspected to occur, but not to the extent to impact either population. However, should one poaching incident occur with the Shell Canyon herd, this could impact that population due to the small population.

### **g. Predation**

Common predators of bighorn sheep include mountain lion, coyote, black bear, and domestic dogs. Additional predators of lambs include bobcats, golden eagles, and red fox. The literature suggests that predator-related mortality significant enough to cause population-level effects to bighorn sheep is rare and localized. This is especially true in the case of bobcats and black bear which on rare occasion may kill a sheep but would most likely prey on sick, injured, very young, or old individuals. Coyotes have been noted in some locations to take lambs at a sufficient rate to suppress a bighorn population. Mountain lions are capable of taking any age class bighorn and may occasionally do so on local herds. For most Rocky Mountain bighorn sheep populations, there is little evidence that lion predation is limiting bighorn sheep numbers. However, lion predation has been found to be a significant source of Rocky Mountain bighorn sheep mortality in individual field studies and in some cases numerous losses can be attributable to a single lion (Viera 2007 *in* George et al. 2009).

Predation is not likely a significant source of mortality that is limiting the bighorn sheep population in Devils Canyon. The WGFD in association with APHIS Wildlife Services did reduce coyote populations in association with the recent augmentations to the Devils Canyon herd. Approximately 20 lions are permitted for harvest in the area surrounding the Devils Canyon herd. It is not known if predation is significant to the Shell Canyon herd, but with so few numbers of bighorn sheep, even one kill is a significant source of mortality on that population. Lion predation on radio-collared bighorns with the reintroduced Shell Canyon herd was documented in 4 mortality cases soon after transplants in 1992-94.

## **2. POPULATION VIABILITY**

A minimum viable population size (MVP) can be defined as the smallest size required for a population or species to have a predetermined probability of persistence for a given length of time (Shaffer 1981 *in* Reed et al. 2003). Information in the current literature supports the fact that large herds of bighorn sheep are less susceptible to factors that may threaten population viability than small herds. However, there is disagreement over how small a bighorn herd population can descend before it becomes non-viable. Singer et al. (2001) suggested that herds with less than 250 individuals were more prone to extirpation than large herds, with small (less than 150 individuals) herds more vulnerable to extirpation from disease outbreaks. Geist (1975 *in* Towry 1984) estimated a minimum viable population of bighorns at 125 individuals and suggested that herds with less than 100 animals should not be hunted. Berger (1990) suggested that bighorn herds of less than 50 individuals were highly susceptible to rapid extirpation while Towry (1984) and others in Beecham et al. (2007) point out that several small herds (50-60 individuals) in the west have continued to persist and even increase despite dropping to these low numbers.

The persistence of some small populations led Towry (1984) to define a minimum viable population of bighorn sheep in Colorado as a herd which contains at least 60 individuals, with up to 45 of those being females and lambs. However, Smith et al. (1991) counter that at least 125 individuals represent the best current estimate of a “minimum viable population” of bighorn sheep although fewer may be needed if adequate connectivity with other sub-populations is maintained. Likewise, the State of New Mexico considers a bighorn sheep herd to be viable if they have at least 100 animals, or are within 15 miles of other populations with which they could interbreed and the size of the resulting metapopulation would be more than 100 animals (New Mexico Department of Game and Fish 2005). Several hundred in a population are recommended to help maintain a high level of genetic diversity (Smith et al 1991, Soule 1980, Soule and Simberloff 1986, Berger 1990, Goodson 1994, Krausman et al. 1996, Wehausen 1999).

Regardless of what a minimum viable population of bighorn sheep may be for a given area, it is apparent that disease epizootics are a primary relevant factor related to population persistence, and that even very large herds are vulnerable to extirpation or reduced health and viability (Beecham et al. 2007, CAST Commentary 2008, George et al. 2009). Thus, even relatively small bighorn herds may be viable and persist or even increase in the absence of disease; however, all herds are susceptible to large-scale die-offs and extirpation when effective separation from domestic sheep is not maintained (Schommer and Woolever 2001). These effects can be compounded by other factors such as habitat limitations, loss of winter range, forage quantity and quality, and habitat fragmentation.

The risk of disease outbreaks resulting from possible contact with domestic sheep and goats is well established in the literature and widely believed to be the most serious threat facing regional bighorn populations. Beecham et al. (2007) evaluated this risk for many of the bighorn herds in Forest Service Region 2, including Wyoming. Beecham’s analysis was based on data received from the Wyoming Game and Fish Department, which did not include any data for the Shell Canyon herd. For the Devils Canyon herd, Beecham concluded that the herd was a medium risk herd, primarily given the potential for disease from domestic sheep.

#### Local Herd Status

The Shell Canyon herd can be summarized as consisting of 10 to 15 animals from the original 111 reintroduced, with some reproduction occurring as one or two lambs may be observed any given year. It is considered by the Wyoming Game and Fish Department to be a non-viable, unhealthy herd (WGFD 2010). Telemetry monitoring has indicated most habitat use of the herd occurs on the Forest in Shell Canyon, with some travel west of the Forest boundary. It is not a core, native herd, since it was developed from transplanted stock.

The Devils Canyon herd can be summarized as consisting of approximately 160 animals, with a long term herd objective of approximately 200 animals. It is not a core, native



herd, since it was developed from transplanted stock. Telemetry monitoring has indicated most habitat use of the herd occurs off of the Forest within the Devils Canyon and Cow Creek areas on BLM land, with some travel east onto the Forest (approximately 3% of observations), and south toward Highway 14A. Refer to maps in Appendix E of the Risk Assessment. The WGFD management intent is to maintain the herd's distribution within the area currently occupied (Easterly 2011), which would likely support up to the 200 animal goal without significant increases in home range. It is considered a healthy, viable herd by these numbers and current lack of disease.

The Bighorn Canyon NRA herd is also thought to be healthy, viable, and consists of approximately 150 to 200 animals. This herd's movements were referenced in Schoenecker (2004), with telemetry locations from that study included in the Risk Assessment.

Refer to maps within the Risk Assessment for more specific locations of each of these three herds and their 95% home range and other movements.

### **3. WYOMING BIGHORN SHEEP MANAGEMENT**

The Wyoming Game and Fish Department (WGFD) is the primary agency responsible for the management of bighorn sheep populations in the state of Wyoming. As such, decisions that the WGFD makes regarding the management of individual bighorn sheep herds (e.g. hunting quotas, relocation efforts, etc.) contribute to the overall status and viability of bighorn sheep.

The WGFD does not currently have a statewide bighorn sheep management plan that sets forth goals for the populations in the state. Rather, individual Job Completion Reports are used to document current and likely future conditions, and management actions needed for each herd.

For bighorn sheep associated with the Bighorn National Forest, only one job completion report exists, which is for the Devils Canyon bighorn sheep herd (WGFD 2009b). The past history, current status and goals for the Devils Canyon herd are described in the Risk Assessment, as summarized from WGFD (2009a).

The Shell Canyon population of bighorns is not recognized as a separate herd currently, due to low numbers and no specific management goals for that population (T.Easterly, pers. comm. 2010). The current status and past history for the Shell Canyon population are described in the Risk Assessment.

### **4. RISK ASSESSMENT AND MANAGEMENT DIRECTION**

#### **Risk Assessment**

The importance of disease transmission to the conservation and long-term persistence of bighorn sheep in Wyoming and elsewhere throughout the west is well documented

(Beecham et al. 2007, CAST Commentary 2008, George et al. 2009). As mentioned previously under the disease section, a recent briefing document from the Washington Office (USFS July 2010) of the Forest Service has recommended conducting risk assessments of potential contact between domestic and bighorn sheep, as has been suggested in other literature (WAFWA 2010, Schommer and Woolever 2001). This briefing document also prescribed the Forest Service to facilitate a multi-partner resolution of wild and domestic sheep conflicts, and references likely forthcoming agency manual direction on this topic.

There is currently no prescribed format, length, or modeling approaches to incorporate into a risk assessment. There are also varying buffers applied for suggested distance separations between domestic and bighorn sheep when assessing potential for contact. It is also recognized that bighorn sheep are capable of wandering great distances (Schommer and Woolever 2001).

Between the Draft and Final EIS for the Big 6 project, the Forest conducted a risk assessment cooperatively with the WGFD. It was formatted on a previous assessment completed on the San Juan National Forest, Pagosa District (USFS 2010e), while considering the past and current efforts surrounding this issue on the Payette National Forest (USFS 2006, 2010). The risk assessment conducted by the Bighorn Forest informs the decision makers of potential risk of contact between domestic and bighorn sheep, and is a part of this BE by incorporation. While it provides a detailed analysis of potential contact sufficient to inform the decision maker, it was not conducted at the same level of rigor as the Payette NF risk assessment. This is primarily due to the fact that none of the three herds considered in this analysis are considered core, native herds, whereas some of those herds analyzed in the Payette documents were, and had funding corresponding to those concerns. The potential risk of contact within the risk assessment conducted for the Bighorn NF project was determined using professional opinion of biologists from both the Forest Service and WGFD, and range managers who are knowledgeable of domestic sheep movements and management practices. It was also based on physical characteristics of the landscape and habitat of bighorn sheep, known bighorn sheep movements, and spatial and statistical analysis available in ArcInfo GIS.

The Risk Assessment also examines potential options or outcomes for bighorn sheep throughout the Forest, outside of the allotments considered in the Big 6 FEIS, and options outside of the current management scenarios of both domestic and bighorn sheep. The Risk Assessment also details consideration of management direction relative to reducing potential contact between bighorn and domestic sheep as described in best available science, and recommends design criteria and adaptive strategies relative to the Big 6 project.

### **USFS Law, Regulation, Policy, Management Direction and Viability Analysis on the Bighorn Forest**

The Bighorn NF Land and Resource Management Plan (Forest Plan) was completed in 2005, and has no pending appeals or litigation encumbering it (as of January 2011). The

Forest Plan provides compliance with the National Forest Management Act (NFMA) of 1976. The NFMA requires that Forest Plans provide for a diversity of species, in a multiple use setting:

“provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives, and within the multiple-use objectives of a land management plan...”  
(Sec 6(3)(B))

Specific direction concerning viability is provided in the 1982 NFMA implementing regulations, under which the Forest Plan was prepared, at 36 CFR 219.19:

“Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area.”

Finally, it is Forest Service policy (FSM 2672.41) to complete a Biological Evaluation “to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native plant or contribute to animal species or trends toward Federal listing of any species.”

The Bighorn Forest Plan and FEIS addressed species viability, including bighorn sheep, by performing large scale ecosystem assessments and fine scale species assessments. From this information, management direction in the form of goals, objectives, standards, and guidelines were developed. Alternatives were developed primarily by different configurations of management area prescriptions, and their associated management direction. From the selected Alternative D of the FEIS, there was no one management prescription or cluster of management prescriptions used to provide for species viability. Rather, the combination of management area prescriptions and forest-wide goals, objectives, standards, and guidelines were used to provide for species viability and other resource, social, and economic needs.

The development of the Plan involved the WGFD as a collaborating partner, described as an agency with cooperating status, and their relationship to the Forest continues in that aspect as a member of the steering committee that monitors and is involved with Plan implementation. In addition, the USFS has a Memorandum of Understanding with WGFD that encourages and allows coordinated planning and implementation of wildlife and fish related issues on the National Forests (FSM 1560, R2 Supplement 1500-2005-1), and recognizes the different agency jurisdictions and authorities.

The following are the Forest Plan goal, objective, and strategies pertaining most to species viability relative to bighorn sheep (Forest Plan, p. 1-2 thru 1-3):

Goal 1: Manage to assure ecosystem health and conservation, using a collaborative approach to sustain the forests, grasslands, and watersheds of the Bighorn NF.

Objective 1.b: Provide ecological conditions and habitat within the ecological capability and disturbance regimes of the Forest to sustain well-distributed viable populations of native and desired non-native emphasis species listed in Appendix C of the Plan.

Strategy 1: Incorporate published conservation strategies for species at risk (TES and local concern) into project design as they are developed, conducting plan amendments when or if necessary to incorporate management direction.

Strategy 2: Proactively conserve populations of emphasis species at risk by maintaining or improving habitat availability and quality when designing projects based on species' habitat needs.

Strategy 3: Improve knowledge of the distribution of species at risk and their habitat... Work with conservation partners in the study, management, and monitoring of these species.

The following are the Forest Plan forest-wide standards and guidelines that pertain most to sensitive species, including bighorn sheep:

Threatened, Endangered, and Sensitive Species Standard 3 (p. 1-40): Avoid actions that would result in a trend toward federal listing or loss of population viability of sensitive species. The protection will vary depending on the species, potential for disturbance, topography, location of important habitat components and other pertinent factors. Give special attention during breeding, young rearing, and other times that are critical to survival of both flora and fauna.

Rangeland Vegetation Guideline 5 (p. 1-31): During Allotment Management Plan (AMP) revision or through vacant allotment assessment, evaluate domestic sheep trailing routes, livestock type, grazing rotation, and other considerations to minimize disease interaction with bighorn sheep.

Wildlife Guideline 5 (p. 1-46): In primary potential bighorn sheep habitat, utilize vegetation management options to enhance habitat by improving forage quality and reducing potential migration barriers (conifer encroachment). Provide interpretive opportunities in viewing areas if and where appropriate. Refer to the administrative record for location of primary bighorn sheep potential habitat.

For a list of management area prescriptions and acres, refer to Chapter 2 in the FEIS for the Big 6 project scale, and Chapter 2 Alternative D-FEIS of the Forest Plan FEIS for the forest-wide scale. This assessment encompasses both of these scales. No specific information or direction pertaining to bighorn sheep management are contained in any of the management area prescription categories in terms of desired conditions, or standards and guidelines associated with them.

Analysis for bighorn sheep occurred with the Forest Plan, which this document incorporates by reference. These analyses include: 2005 Forest Plan FEIS Chapter 3 summary of effects (pgs. 3-119 to 3-122); Bighorn Sheep Species Assessment (2005 FEIS project record); Viability Analysis Process document (2005 FEIS project record); Viability Analysis – Ecological Assessments document (2005 FEIS project record). The BE for the Forest Plan (FEIS Appendix K, pg. 1-88), did not include bighorn sheep, as they were not listed as a sensitive species. Under the Forest Plan, bighorn sheep were designated as a species of local concern as displayed in the Forest Plan FEIS, and as analyzed in the emphasis species form prepared for bighorn sheep (2005 FEIS project record). In 2007, and again in 2009, bighorn sheep were listed as a sensitive species in Region 2 (USFS 2009). In 2010, the Bighorn NF released Administrative Correction #1 for the Forest Plan containing the revised and updated emphasis species in the Plan, with bighorn sheep listed as a sensitive species.

Within the FEIS for the Forest Plan (pgs. 3-119 to 3-122), and the Viability Analysis Process document (pgs 8, 17, 45, 48, 51), bighorn sheep were determined to have a low likelihood of persistence, or high risk for viability, mostly due to potential disease transmission with domestic sheep, both on and off the Forest. This was described as Outcome E which stated:

The combination of environmental and population conditions restricts the potential distribution of the species, which is characterized by high levels of isolation and very low potential abundance. Gaps where the likelihood of population occurrence is low or zero are large enough there is little or no possibility of interactions, strong potential for extirpations, and little likelihood of recolonization. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

As displayed in the bighorn sheep species assessment for the Forest Plan (2005 FEIS project record), this determination was made considering the Shell Canyon herd (pgs. 3 – 5). As also displayed in the Forest Plan species assessment (p. 1), the Shell Canyon herd was not considered viable at the time of the Forest Plan preparation, and therefore the action words in the viability (36 CFR 219.19) language of “maintain”, and the Forest Plan objective of “sustain” were not considered applicable to this population of sheep, as it was not viable, nor had there been a viable herd of bighorn sheep on the Forest since the early 1900’s, before the NFMA and implementing regulations.

Although mentioned in both the bighorn sheep species assessment, and the emphasis species form associated with the Forest Plan FEIS, the Devils Canyon herd at that time was small enough and had only been recently augmented with a transplant. The herd was not known to occur on the Forest, nor within any likely contact distance with permitted domestic sheep grazing or trailing. Maintaining this separation between domestic and bighorns was part of

the goal of the WGFD associated with the transplant by selecting non-migratory bighorn sheep. In addition, the WGFD management objective for this herd did not target occupying habitat on the Forest. Because of these reasons, the Forest Plan FEIS viability determination was not made with respect to the Devils Canyon herd. As stated previously, this is one of the reasons for this supplemental BE, to perform that analysis and determine if Bighorn NF management actions would affect the viability of the Devils Canyon herd.

## **IV. EFFECTS ANALYSIS AND DETERMINATIONS**

### **1. Big 6 Project FEIS**

The management actions as proposed in the alternatives associated with the Big 6 project may have direct, indirect, and cumulative effects associated with bighorn sheep. The following analysis displays those effects by alternative, by bighorn sheep herd. For the purposes of this analysis, the risk of contact between bighorn and domestic sheep, with the potential for disease transmission, will be considered a potential direct effect. While it is noted in the CAST Commentary (2008) that not all contacts between domestic and bighorn sheep result in the transmission of disease, a conservative approach is warranted regarding this issue. Thus, it was estimated that any contact could result in the transmission of disease, and therefore a negative effect. Indirect effects would include those activities associated with livestock grazing or other actions proposed that may either displace bighorn sheep or create forage competition. Cumulative effects consider those stressors both within and adjacent to the Forest that may have an impact on bighorn sheep or their habitat. Information presented in the Risk Assessment is incorporated by reference into this analysis. Individual herd viability determinations are made in this analysis for the Shell Canyon and Devils Canyon herds, and an overall determination of effects (FSM 2672.42) is made regarding bighorn sheep for each alternative. The Bighorn Canyon National Recreation Area bighorn herd is considered in this analysis in terms of cumulative effects, however as this herd does not occupy the Forest, direct viability determinations were not made.

The timeframe for which effects are considered in this analysis are bounded by the next likely Forest Plan Revision in 2020, and within the typical NEPA compliance for project level decisions, approximately 10 years. It is also recognized that the Risk Assessment would be revised after 5 years or sooner if necessary, and that population and disease related dynamics could take longer or shorter than 10 years to manifest themselves. Viability determinations are therefore similarly bounded by short term (within 10 years) to long term (20+ years) predictions.

#### **a. Alternative 1**

Under this alternative, there would be no domestic livestock grazing within the Big 6 project area allotments.

#### ***Shell Canyon Herd***

This alternative would have the least potential for direct effects to Shell Canyon bighorn sheep. With domestic sheep allotments being vacant in the project area, there would be no potential for contact.

Similarly, there would be no potential for indirect effects from livestock management with regard to herding activities that could displace bighorn sheep, or from any forage competition.

Cumulative effects that are currently occurring include recreation, fire, and other livestock management activities within the watershed and adjacent to the Forest that may have an effect on this herd. These activities include the private domestic sheep flock that is approximately one mile west of the Forest in the bottom of Shell Canyon, which has high potential for contact as assessed in the Risk Assessment. This domestic sheep herd has no relation to permitted livestock on the Forest, so this risk of contact would continue regardless of not stocking the allotments in the project area. Since this domestic flock is adjacent to the Forest in a year round setting, it poses a higher risk for contact than the domestic sheep that are currently permitted on the Forest, which are only on the Forest during summer months.

In addition to the private flock of domestic sheep, there are other domestic sheep allotments and trailing activities within the Shell Canyon watershed that have a moderate to high risk of contact potential with bighorn sheep, as displayed in the Risk Assessment. There are also domestic sheep in the watersheds adjacent to Shell Canyon, as displayed in the Risk Assessment, that have an estimated low to moderate risk of contact with the Shell Canyon herd. None of these allotments are associated with the Big 6 decision, and grazing activities would continue regardless of this alternative. Domestic sheep strays from these allotments or trailing could continue to be a source of potential contact and disease transmission, in addition to the main flocks or bands of sheep grazed on the Forest. Other ongoing domestic sheep grazing in other parts of the Tongue and Powder River Districts were rated a very low risk of contact in the Risk Assessment, generally due to the greater distance of separation and/or physical barriers between bighorn and domestic sheep.

Recreation activities that are ongoing in the Shell Canyon watershed include hiking, mountain biking, pleasure driving, wildlife viewing, and hunting activities. In addition, the road traffic on Highway 14 is a potential source of mortality for bighorn sheep. There is also the potential for domestic pack goats to be used in the watershed for recreation purposes. These goats could have some potential for contact, though at very short term intervals compared to permitted domestic sheep grazing. All of these have potential to displace bighorn sheep, possibly from preferred habitat. However, none of these uses have currently been identified as impacting bighorn sheep, likely due in part to the few numbers of sheep and the amount of available habitat.

Prescribed fire and wildfire activities would also continue to occur within the watershed. Typically, these management activities are short term in duration, allowing the sheep to disperse to other areas, and may provide long term beneficial effects. Other vegetation management projects in the Shell watershed include timber harvest. Typically these activities, while they may generate noise and displace sheep in the short term, are either

occurring in non-potential habitat (timber stands), or are actually creating openings that may help sheep disperse through a timbered area into other potential habitat.

Based upon poor population performance as described in this BE and the Risk Assessment, and the existing cumulative effects due to domestic sheep grazing on private lands adjacent to the Forest and grazing allotments on the Forest outside the Big 6 project area, it is anticipated Alternative 1 would not likely provide for conditions to establish a viable bighorn sheep herd within the Shell Canyon watershed within the foreseeable future. This determination is consistent with the Forest Plan FEIS viability determination.

#### *Devils Canyon Herd*

The direct, indirect, and cumulative effects as described above for the Shell Canyon herd would be similar for the Devils Canyon herd. However, there are no domestic sheep allotments immediately adjacent to the Devils Canyon herd, as compared to the Shell Canyon herd, as displayed in the Risk Assessment.

Alternative 1 would have the least potential for direct effects to Devils Canyon bighorn sheep. With domestic sheep allotments being vacant in the project area, there would be no potential for contact. In addition, there would be no trailing of domestic sheep along Highway 14A, which eliminates the potential risk of contact between bighorns and domestic sheep along this route.

Similarly, there would be no potential indirect effects to the Devils Canyon herd from livestock management with regard to herding activities that could displace bighorn sheep, or from forage competition.

Cumulative effects that are currently occurring include recreation, fire, and other livestock management activities near the Devils Canyon herd, and adjacent to the Forest that may have an effect on this herd. These activities include other domestic sheep allotments and trailing activities in the headwaters of the Tongue and Little Bighorn watersheds that could provide contact opportunity with the Devils Canyon herd, if either staying of domestic sheep occur or if the Devils Canyon herd wanders or expands more onto the Forest. However, the risk rating applied in the Risk Assessment to these allotments ranged from low to very low for potential contact. Similarly, risk ratings for other domestic sheep allotments in the Forest on the Tongue and Powder River Districts were rated very low for potential contact. Refer to maps and risk ratings in the Risk Assessment.

In addition to the domestic sheep grazing, there is a greater potential for contact between the existing Shell Canyon bighorn herd and the Devils Canyon herd. As displayed in the Risk Assessment, Shell Canyon herd individuals have been known to wander north along the west face of the mountains, and Devils Canyon herd individuals have been known to wander south of Cottonwood Canyon, near Highway 14A. If these movements coincided, there could be contact between these herds, with a potential for disease transmission, assuming that the Shell herd is either infected or a carrier. The ongoing efforts of the WGFD to manage against this contact would likely continue, and thus reduce the risk associated with this potential contact. This risk was estimated to be of moderate risk within the Risk Assessment.



Finally, there could also be contact with the Bighorn Canyon NRA herd, whose range has been known to overlap the Devils Canyon herd as displayed in the Risk Assessment. Should the Bighorn Canyon herd become infected by the domestic goat flock near the NRA, disease could be transmitted to the Devils Canyon herd.

Recreation activities that are ongoing in the Porcupine and Cottonwood watersheds include hiking, mountain biking, pleasure driving, wildlife viewing, and hunting activities. In addition, the road traffic on Highway 14A is a potential source of mortality for bighorn sheep. All of these have potential to displace bighorn sheep, possibly from preferred habitat. However, none of these uses have currently been identified as impacting bighorn sheep, likely due in part to the few numbers of sheep and the amount of available habitat.

Prescribed fire and wildfire activities would also continue to occur within the watersheds. Similarly, these management activities have not been known to be of effect to the sheep, and they are typically short term in nature, allowing the sheep to disperse to other areas. There are historic timber sales near the Forest boundary in these watersheds, although none are ongoing or proposed.

Considering the potential cumulative effects, it is anticipated that Alternative 1 would have the least potential risk of contact of the three alternatives between bighorn and domestic sheep grazed on the Forest. However, the risk of contact with the Shell Canyon herd remains. With WGFD ongoing management, the bighorn sheep in Devils Canyon would likely continue as a viable herd.

#### *Bighorn Canyon NRA Herd*

There would be no potential direct, indirect, or cumulative effects to this herd from implementing Alternative 1, because there would be no potential of contact associated with domestic sheep grazing on the Forest.

#### *Determination*

The applicable determination for this alternative for bighorn sheep, as described in Forest Service manual direction for sensitive species (FSM 2672.42), is “**no impact**”. This determination applies only to Forest Service past, present, and reasonably foreseeable future related actions as described in the alternative and effects, not to other cumulative effects, such as domestic sheep on private land adjacent to the Shell Canyon herd. The risk of disease transmission through contact was considered the highest factor in this determination, while other ongoing activities and cumulative effects such as recreation are not thought to be hindering the populations at this point.

In addition, this alternative is consistent with Forest Plan direction, including the goal, objective, strategies, and standards and guidelines as listed previously.

#### b. Alternative 2

Under alternative 2, the current levels of permitted domestic sheep grazing and the current management activities would continue. There would be no added design criteria or adaptive management strategies to address the potential risk of contact with bighorn sheep.

### *Shell Canyon Herd*

This alternative would have the greatest potential for direct effects to Shell Canyon bighorn sheep. Occupied domestic sheep allotments within the project area would present the highest potential for contact between domestic and bighorn sheep.

Similarly, there would be the greatest potential for indirect effects from livestock management with regard to herding activities that could displace bighorn sheep, or from any forage competition.

All of the cumulative effects described under Alternative 1 for the Shell Canyon herd would similarly occur for this alternative.

Considering these direct, indirect, and cumulative effects, it is anticipated that Alternative 2 would not likely provide for conditions to establish a viable bighorn sheep herd within the Shell Canyon watershed within the foreseeable future. This determination is consistent with the Forest Plan FEIS viability determination.

### *Devils Canyon Herd*

The indirect and cumulative effects as described in Alternative 1 for the Devils Canyon herd would apply for the Devils Canyon herd under Alternative 2. The direct effects are different, in that the vacant allotments and absence of trailing under Alternative 1 would now be used by domestic sheep.

This alternative would have the most potential for direct effects to the Devils Canyon bighorn sheep. The grazing allotments at the north end of the Beaver Creek project area are closer to this herd, and were rated as moderate risk for contact in the Risk Assessment. The livestock trailing up Highway 14A in this alternative was rated as high risk. There are no design criteria or adaptive strategies in this alternative that would minimize potential contact between domestic and bighorn sheep associated with trailing. There are no domestic sheep allotments immediately adjacent to the Devils Canyon herd, as compared to the Shell Canyon herd, as displayed in the Risk Assessment.

Under Alternative 2, there would be a low likelihood of potential indirect effects from livestock management with regard to herding activities that could displace bighorn sheep, or from any forage competition, on allotments near the Devils Canyon herd that they could potentially use in the future.

The cumulative effects as discussed under Alternative 1 for the Devils Canyon herd would be similar under this alternative. Considering these cumulative effects, the ongoing livestock grazing and lack of design criteria and adaptive strategies to prevent contact, it is anticipated that Alternative 2 would have the most risk of contact of the three alternatives between bighorn and domestic sheep grazed on the Forest. In addition, the risk of contact between the

Shell Canyon herd and Devils Canyon herd remains. It is uncertain that the Devils Canyon herd would persist in terms of viability under this alternative, even with WGFD ongoing management to minimize spread of the Devils Canyon sheep and interaction with the Shell Canyon herd.

#### *Bighorn Canyon NRA Herd*

There would be no direct or indirect effects from Alternative 2 to the Bighorn Canyon NRA herd, however there are potential cumulative effects. Should contact between domestic sheep and the Devils Canyon bighorn sheep herd occur, and disease was transmitted, then the Bighorn Canyon NRA herd could also become infected by the Devils Canyon sheep due to the home range overlap of these two herds. This was estimated to be of low risk within the Risk Assessment.

#### *Determination*

The applicable determination for Alternative 2 for bighorn sheep, as described in Forest Service manual direction for sensitive species (FSM 2672.42), is **“likely to result in a loss of viability in the Planning Area, or in a trend toward federal listing”**. This determination applies only to past, present, and reasonably foreseeable future Forest Service related actions as described in the alternative and effects, not to other cumulative effects, such as domestic sheep on private land adjacent to the Shell Canyon herd. It also assumes that contact between bighorn and domestic sheep, should it occur, results in a disease transmission. However, if both the Devils Canyon and Shell Canyon herds were to experience die-offs, a simultaneous rangewide die-off would potentially need to occur across Wyoming and possibly other western states to likely warrant a proposed listing of Rocky Mountain bighorn sheep under the Endangered Species Act.

While this alternative is consistent with Forest Plan direction, including the goal, objective, strategies, and standards and guidelines as listed previously when considering the Shell Canyon herd, it would not conform to the objective and strategy of “sustaining” the viable Devils Canyon herd.

#### c. Alternative 3

In this alternative, current permitted domestic sheep grazing would continue with the following exceptions. The establishment of a forage reserve allotment within the Beaver Creek project area from the closed Hunt Mt S&G allotment, the closure (conversion to cattle) of the Grouse Creek S&G allotment, and closure of parts of the Beaver Creek S&G allotment. The major difference between Alternatives 2 and 3 is the added design criteria and adaptive management strategies to minimize the potential risk of contact with bighorn sheep. These were developed in the Risk Assessment as part of reviewing other management recommendations from the best available science resources. This analysis assumes these are incorporated into the FEIS for inclusion under this alternative. These would apply to the allotments considered within the Big 6 project area, and specifically in proximity to the Devils Canyon herd. The design criteria and adaptive management strategies would not apply outside allotments included in the Big 6 project, except for signing and information handouts to warn of potential contact and to provide agency contact information.

The design criteria and adaptive strategies were developed by the ID Team, with input from WGFD, livestock permittees, and from DEIS comments. Their development was an iterative process. After the DEIS comment period, the design criteria in the DEIS were supplemented to reflect the development of the Risk Assessment, to decrease the probability of contact between the Devils Canyon herd and domestic sheep. Several members of the team that developed the design criteria have more than 15 years of experience managing wildlife and livestock on the Bighorn NF and vicinity.

The other potential actions in Alternative 3 include prescribed fire activities and the use of domestic goats or sheep for weed control. Goat or sheep grazing for weed or brush control would occur near the Forest boundary at the bottom of the Little Bighorn drainage on the east side of the Forest, and near West Pass on the east side of the Forest. There would be design criteria associated with the prescribed fire activities to benefit bighorn sheep under this alternative. In addition, there would be design criteria to manage against potential contact between recreation pack goats and the Devils Canyon bighorn herd, which would be implemented outside of the Big 6 decision through special order designation.

#### *Shell Canyon Herd*

Alternative 3 would have moderate potential for direct effects to Shell Canyon bighorn sheep. With domestic sheep allotments and trailing routes being occupied in the project area, there would be potential for contact between the two. Alternative 3 reduces potential risk greater than Alternative 2. A few allotments in the Shell watershed would be closed or converted as described in Alternative 3, reducing the risk ratings associated with those allotments to “none” as described in the Risk Assessment.

Similarly, Alternative 3 would reduce potential for indirect effects from livestock management with regard to herding activities that could displace bighorn sheep, or from any forage competition, as compared to Alternative 2. This is due to the fewer stocked domestic sheep allotments as compared to Alternative 2.

All of the cumulative effects described under Alternatives 1 and 2 for the Shell Canyon herd would similarly occur for this alternative. In addition, there could be potential benefits for bighorn sheep associated with the prescribed burning proposed in Alternative 3, expanding potential bighorn sheep range. Conversely, a potential negative effect of prescribed burning could be the removal of movement barriers (timber) that could increase the potential for interaction with the Devils Canyon herd, to the detriment of that herd. For this reason, a design criterion was recommended to coordinate with WGFD and the BLM for any vegetative management treatments planned along the western edge of the range to ensure treatment does not increase potential for contact. Also, the addition of signing and literature to warn of the contact risk between bighorn and domestic sheep may reduce risk contact through permittee awareness and quicker agency notification.

Considering these direct, indirect, and cumulative effects, it is anticipated that Alternative 3 would not likely provide for conditions to establish a viable bighorn sheep herd within the Shell Canyon watershed in the reasonably foreseeable future. However, Alternative 3 likely reduces the level of risk of contact over Alternative 2, due to less occupied allotments and the

addition of design criteria (contact signing and notification). This determination is consistent with the Forest Plan FEIS viability determination.

#### *Devils Canyon Herd*

The direct, indirect, and cumulative effects as described in Alternative 2 above for the Devils Canyon herd would be somewhat similar under Alternative 3. However, the recommended addition of design criteria and adaptive management strategies, in conjunction with other WGFD management activities, results in a reduced risk of contact and greater separation between domestic sheep and the Devils Canyon herd. In addition, there are fewer stocked domestic sheep allotments in the Beaver Creek project area, should the Devils Canyon herd expand beyond its current occupied range.

This alternative would have moderate potential for direct effects to Devils Canyon bighorn sheep. The grazing allotments at the north end of the Beaver Creek project area are closer to this herd, and were rated a moderate to low risk for contact in the Risk Assessment. The trailing of domestic sheep up Highway 14A was rated a moderate risk of contact under this alternative, as compared to the high risk under Alternative 2. There are no domestic sheep allotments immediately adjacent to the Devils Canyon herd, as compared to the Shell Canyon herd, as displayed in the Risk Assessment. Under Alternative 3, it is anticipated that the overall risk of contact would be less than Alternative 2. Adaptive management strategies, which would likely require time to implement, allow for the closure of domestic sheep trailing along Highway 14A (convert to trucking) and also allow for the removal (either through transfer or closure) of domestic sheep allotments that could potentially be in contact range of the Devils Canyon herd.

Under Alternative 3, there would be a low likelihood of potential indirect effects from livestock management with regard to herding activities that could displace bighorn sheep, or from any forage competition, on allotments near the Devils Canyon herd that they could potentially use in the future.

It is anticipated that the cumulative effects as discussed under Alternatives 1 and 2 for the Devils Canyon herd would be similar under this alternative. However, Alternative 3 includes the addition of design criteria and adaptive management strategies, which reduces the overall risk of contact as compared to Alternative 2. The risk of contact with the Shell Canyon herd remains similar as described previously. It is of good certainty that the Devils Canyon herd would persist under this alternative, including WGFD's ongoing management strategies to maintain the current range of the Devils Canyon sheep and prevent interaction with the Shell Canyon herd.

Under Alternative 3, one of the strongest design criteria to be included of benefit to bighorn sheep is to revisit the Risk Assessment after 5 years, or sooner if changed conditions become apparent. This would allow for the application of adaptive strategies, or the implementation of entirely different strategies, such as those considered in the Risk Assessment under "opportunities considered". There are at least two realms of changed conditions that could lead to different future actions. First, the viability of the Devils Canyon herd may be threatened by contact with domestic sheep permitted by the Forest. If the design criteria do

not achieve the stated goals for precluding interaction, some or all of the adaptive strategies would be implemented. Second, there could be a change in the Forest Plan objectives, for either livestock grazing or bighorn sheep on the Forest. The collaborative objective setting process that occurs at the time of revision can take into account partners' input, including that of the WGFD, the state-wide working group, interested citizens, and affected permittees. The sheep industry in the United States has declined over the past several decades (Forest Plan FEIS), and similar events in the future could also affect the objective setting process in future Forest Plan revisions. For all of these reasons, it is possible that the Devils Canyon herd may expand in future years, increasing their occupied range on the Forest and potential viability, assuming there is less risk of contact with domestic sheep. As most wandering or expansion of bighorn sheep appears to be correlated to breeding season, there is also less risk for this herd contacting domestic sheep since domestic sheep are removed by October, prior to wandering periods observed in bighorn sheep.

It may also be likely that some loss of domestic sheep numbers or permittees occurs on the Forest, regardless of Forest Service administrative actions, due to overall economic conditions in the domestic sheep industry, which has seen large declines in the past several decades of number of operators and sheep.

It is of good certainty from this analysis that the proactive, interagency management strategies intended to conserve and promote population viability for the Devils Canyon bighorn sheep herd in Alternative 3, would be successful. Thus, the species diversity and viability requirements of the Forest Plan and other direction (FSM 2670, NFMA, 36 CRF219.19) would be met on the Forest as represented by this healthy, viable herd.

#### *Bighorn Canyon NRA Herd*

There would be no direct or indirect effects from Alternative 3 to this herd, and the potential cumulative effects described in Alternative 2 would also apply under Alternative 3. However, effects associated with domestic sheep grazing would be reduced over Alternative 2, as design criteria and adaptive management strategies would be applied, and reduced levels of domestic sheep grazing would occur over Alternative 2.

#### *Determination*

The applicable determination for Alternative 3 for bighorn sheep, as described in Forest Service manual direction for sensitive species (FSM 2672.42), is **“may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing”**. This determination applies only to past, present, and reasonably foreseeable future Forest Service related actions as described in the alternative and effects, not to other cumulative effects, such as domestic sheep on private land adjacent to the Shell Canyon herd or the Shell Canyon herd interacting with the Devils Canyon herd. This determination is also based on the likelihood that the Shell Canyon herd (10-15 individuals) may or may not persist as a non-viable population, thus indicating a potential loss of individuals due to potential contact and disease transmission with domestic sheep on the Forest, and other factors such as predation. The Devils Canyon herd would remain viable based on effective separation of bighorn sheep and Forest Service permitted domestic sheep by application of design criteria and adaptive strategies, including WGFD coordination.

This determination assumes that contact between bighorn and domestic sheep, should it occur, results in a disease transmission. Finally, if both the Devils Canyon and Shell Canyon herds were to experience die-offs, a simultaneous widespread die-off would potentially need to occur in Wyoming and possibly other western states to likely warrant a proposed listing of Rocky Mountain bighorn sheep under the Endangered Species Act.

This analysis concludes that the Shell Canyon herd remains at risk and may not increase to a viable herd status in the foreseeable future. However, there are two tangible benefits from the Big 6 decision to this herd. First, the heightened awareness of potential contact concerns with Forest personnel, WGFD, permittees and herders will help identify existing or future problems on the Forest regarding contact. This may also lead to removing the Shell Canyon individual bighorns that are more prone to seeking contact. Second, the closure of two domestic sheep allotments on the Forest in proximity to that herd should help reduce potential contact. The “forage reserve” allotment that will remain has a low likelihood of being used by domestic sheep, as it has not been grazed in several years. These are reflected in Alternative 3 as the conversion of Grouse Creek S&G to a C&H allotment, and the Red Canyon and Hunt Mtn. S&G allotments being established as forage reserves, in addition to closure of parts of the Beaver Creek S&G allotment.

This analysis concludes that the Devils Canyon herd will be managed for a viable herd in the foreseeable future, with successful management for effective separation with domestic sheep permitted by the Forest Service, and the WGFD actions associated with the Shell Canyon herd which may carry disease. This is given the coordinated management efforts between the WGFD, Forest Service, and livestock permittees. The Devils Canyon herd, as it is healthy, viable, and occurs on the National Forest, also meets the population viability responsibilities of the Forest as defined by 36 CFR 219.19, and the “diversity” requirement as defined by the NFMA.

Alternative 3 is consistent with Forest Plan direction, including the goal, objective, strategies, and standards and guidelines as listed previously when considering the Devils Canyon herd. It is also consistent with the Forest Plan direction in that the Shell Canyon herd is not currently viable, and thus would not fall under the “sustain” viability objective and strategy listed in the Forest Plan.

<b>Summary of Bighorn Sheep Determinations for the Big 6 Project Alternatives</b>		
Alternative 1	Alternative 2	Alternative 3
No Impact	Likely to result in a loss of viability in the Planning Area, or in a trend toward federal listing.	May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.
Consistent with Forest Plan direction.	Not consistent with Forest Plan direction.	Consistent with Forest Plan direction.

## **2. Forest-Wide Scale Effects/Forest Plan Alternatives**

This section provides a supplement to the Forest Plan BE (FEIS Appendix K). The purpose of that BE was to assess the alternatives considered, and other management direction, to determine if those proposed actions would affect the sensitive species considered. At the time of the Forest Plan completion in 2005, bighorn sheep were not a sensitive species. They were added by the Region in 2007 and subsequent years. Emphasis Species were developed during the Forest Plan to guide implementation so that project level evaluations could determine if management actions were sustaining viability, as indicated in the objective and strategies mentioned previously. The Emphasis Species to which this direction applied were listed in Appendix C of the Forest Plan (not FEIS). This list has been updated in subsequent years through “errata” or “administrative correction” publications to respond to changes in regional sensitive species list changes. It was last updated in 2010 to reflect the 2009 regional sensitive species list changes. However, with the importance of the potential disease transmission issue relative to bighorn sheep and domestic sheep and goat grazing, a management review of the existing plan direction and alternatives was warranted due to potential viability ramifications for bighorn sheep.

### **a. Forest Plan Alternatives, Management Direction, and Biological Evaluation**

The Forest Plan alternatives were developed by an interdisciplinary team in response to public and other comment. In addition to the six main alternatives considered in Chapter 2 of the Forest Plan FEIS, the range of alternatives also included several “Alternatives Considered but Not Analyzed in Detail” (Plan FEIS, Ch. 2 pgs. 26-36). One of these alternatives specifically addressed “no domestic sheep grazing”, in response to the potential disease transmission issue with bighorn sheep. As stated on page 2-26 of the FEIS, it was not carried further as: a) the Shell Canyon bighorn sheep herd had opportunity to be infected by domestic sheep adjacent to the Forest on private land, b) the Forest had recently received a transfer of domestic sheep from the Shoshone NF to help emphasize Wyoming’s statewide viability of core, native bighorn herds on the Shoshone, and c) the Forest Plan contained a guideline to address the potential disease transmission issue during allotment management planning, as reflected in the analysis being conducted for the Big 6 project.

The Forest Plan BE addressed effects to species according to their habitat association, and any additional species specific information. Bighorn sheep would have fallen under three possible habitat associations, including Cliffs/Rock Outcrops, Alpine Tundra, and Grassland/Sagebrush Steppe. As radio collar data indicates that most time is spent in grass/sage steppe, this would have been the most likely place under which the analysis would have fallen (FEIS Appendix K, pgs. K-86-89). The finding for the species in this habitat group, as well as other habitat groups, was that the alternatives did not have a significant difference to warrant a different determination (FEIS Appendix K, p. K-89). This was based on the inclusion of forest-wide standards and guidelines that offer protection and mitigation regardless of each alternative (FEIS Appendix K, p. K-42). The BE also addressed the measure of uncertainty that should be considered with the determinations made (FEIS Appendix K, p. K-2). Another Alternative Considered but Not Analyzed in Detail examined varying the standards and guidelines by alternative. This option was not analyzed further as



the package of standards and guidelines was based on species and ecosystem assessments conducted, and the complexity of analysis of this approach would be prohibitive (FEIS, p. 2-31). The standard and guidelines listed previously are the main foundations for this determination, and ongoing implementation of the Forest Plan.

b. Viability and Species Determination for Bighorn Sheep Herds

The range of alternatives considered in the Forest Plan included the “no domestic sheep grazing” alternative considered but not analyzed in detail. The range of alternatives provided an adequate range to assess the potential viability of bighorn sheep, including the changed condition of the Devils Canyon herd expanding into a population that now occurs on the Forest. The rationale for this is similar to that described in the determinations in the Forest Plan BE. The standards and guidelines adopted with the Forest Plan give resource managers and line officers sufficient direction to assess effects, particularly with regard to potential disease transmission between domestic and bighorn sheep. Management direction affords adequate protection by mandating in a standard that needed protection for sensitive species is implemented. It is important to note that the standards and guidelines in the Forest Plan were developed to enable the implementation of the overall goals, objectives, and strategies listed in the Forest Plan. Therefore, the strategy of “sustaining viability” is the criteria to consider when implementing the standards and guidelines. In the case of the Shell Canyon herd, there is no viable population to sustain. In the case of the Devils Canyon herd, there is a viable population, with known use of the Forest, which is also the “planning area” as referenced in the 36 CFR 219.19 regulation that addresses viability.

The Risk Assessment conducted with this analysis, as incorporated by reference, assessed the forest-wide scale of potential contact between domestic and bighorn sheep. Refer to the analysis presented under the Assessment 1 (No action/no domestic sheep grazing) and Assessment 2 (current domestic sheep grazing) headings in the Risk Assessment. The process utilized for the Big 6 project area risk ratings was used to arrive at the risk ratings of contact between domestic and bighorn sheep outside of the Big 6 project area. Under Assessment 2, the ratings varied from low to very low risk of contact between the Devils Canyon herd and domestic sheep allotments outside of the Big 6. This is primarily due to the fact that Big 6 project area allotments, specifically those within the Beaver Creek project area, are closest to the Devils Canyon herd, and therefore have the most potential for contact. The risk ratings for the Shell Canyon herd varied from high to very low risk of contact in Assessment 2, depending upon the interdisciplinary team’s understanding of the distance of allotments from that herd, temporal use of the area by domestic and bighorn sheep, physical barriers, and topography. The result under Assessment 1 for the Devils Canyon herd was a risk rating of none, and similarly for the Shell Canyon herd.

The assessments, however, did not take into account off Forest potential contact with domestic sheep, as the assessments only targeted USFS permitted domestic sheep grazing. Therefore, the viability considerations as described under the Big 6 project area alternative analysis also apply to a viability determination at the forest-wide scale. These include the off Forest private domestic sheep grazing near Shell, WY, and potential interactions between the Devils Canyon and Bighorn Canyon NRA bighorn sheep herds. There are also private

domestic sheep grazed near Tensleep, WY and off the east side of the Big Horn mountains. These off-Forest domestic sheep grazing activities could become a factor if an objective to re-establish bighorn sheep throughout the Big Horn mountains or the Forest were developed. The Forest Plan does not have an objective for re-establishing bighorn sheep throughout the Forest. Private land domestic sheep grazing which occurs adjacent to the Forest would need considered, should there be an objective added, through revision or amendment.

Given the current status and distribution of the Devils Canyon (healthy, viable) and Shell Canyon (non-viable) bighorn herds, the existing Forest Plan guideline (rangeland vegetation #5) and Forest Plan standard (TES #3) provide necessary direction to managers to incorporate changed conditions as they become evident during the allotment management plan review schedule, or as vacant allotments are identified. Bighorn sheep could expand onto the Forest in advance of either the allotment management plan review schedule or vacant allotment identification. However, the inclusion of the design criteria within the Big 6 project decision with alternative 3 that requires re-examining the Risk Assessment within 5 years or if changed conditions warrant, provides procedure for early detection necessary to trigger any other needed changes in domestic sheep management. Since the Risk Assessment identified 95% core herd use areas and 5% outer use areas which are most likely to have expansion from either herd, this measure is sufficient to provide managers and line officers the impetus to consider potential new conditions to protect bighorn sheep viability of the Devils Canyon herd, and thus provide viability for this species on the Forest, both in the short and long term.

Also of importance within the Risk Assessment are the considerations of other opportunities or potential changed conditions with regard to either the Shell or Devils Canyon herds. These opportunities that were examined as potential future outcomes, would also be revisited within the Risk Assessment, and provide managers and line officers the impetus to consider if new Forest Plan direction, or other site specific NEPA, was needed to address the conditions. Forest Plans, and specifically the past Bighorn Forest Plan (1985 plan had 14 amendments), have been subject to amendments, which is part of what keeps the plans alive and implementable given other laws and regulations. The current Forest Plan would need revised by 2020, unless newer planning rules state otherwise.

In addition to management direction in Chapter 1 and 2 of the Forest Plan, Chapter 4 also includes monitoring actions. Monitoring actions are documented in an annual or 5 year monitoring report prepared by the Forest, according to the schedule in Chapter 4. There is currently no specific monitoring element for bighorn sheep and potential contact with domestic sheep in Chapter 4. Again, the project specific monitoring prescribed with the Big 6 project, as developed in the Risk Assessment, meets the Forest's requirement at this time, due to the spatial and temporal considerations of the bighorn sheep to domestic sheep analyzed by this EIS. These activities can be reported in the annual Forest Plan monitoring report, as tied to Monitoring Driver 9, Items 6 and 7, Species Viability Monitoring, and additional project specific monitoring reports.

At this time, it is not evident that the Forest Plan needs amended to incorporate any new direction for potential bighorn sheep management concerns. Future conditions may change,

and the Plan could need amended. This determination is based on the distribution of existing bighorn sheep populations in Shell Canyon and Devils Canyon, the current non-viable status of the Shell Canyon herd, the current viable status of the Devils Canyon herd, and relevant project specific design criteria and adaptive strategies within the Big 6 project that also benefit the species at the forest-wide scale.

Other standards and guidelines, such as those implemented recently on the Payette National Forest (Payette NF 2010 Amendment to the Forest Plan), were considered by the Forest. These standards and guidelines were developed for the core, native bighorn sheep herd that occurs on the Payette, in a more broadly dispersed population. At this time, the Bighorn NF would not need such widespread direction applicable to the entire Forest, when proposed project level direction (design criteria and adaptive strategies in Big 6 Alternative 3) provide direction to ensure viability of the Devils Canyon herd. In addition, the direction to “sustain viability” in the Forest Plan objective and strategy provide continued direction to maintain viability for the Devils Canyon herd. Should the management position taken by the WGFD (Easterly 2011) of the Bighorn Mountains being a non-emphasis area for bighorn sheep change, an amendment to the Forest Plan may be necessary.

Determining the long-term persistence of bighorn sheep on the Bighorn National Forest involves uncertainty. As evidenced by the conservation status and history section of bighorn sheep in this analysis, it is impossible to precisely determine which herds on the Forest may be secure and which may not. Small herds could persist and large herds may perish, or vice versa, with susceptibility to disease identified as the primary relevant factor influencing this outcome. The determination for this analysis is further complicated by factors such as the incomplete knowledge base associated with the disease transmission issue on natural range, difficulties in attaining accurate population counts, habitat and management actions beyond the control of the USFS, and the uncertainty associated with effectiveness of the design criteria recommended for maintaining effective separation between bighorn sheep and domestic sheep, and the extent of straying domestic sheep and wandering bighorn sheep. What is known, however, is that maintaining and improving the health of bighorn populations depends on preventing respiratory disease epidemics and that preventing potential contact with domestic sheep and goats is particularly important to the success of these efforts.

Based on the above analysis and rationale, the determination in the Forest Plan BE made for the grassland/sage steppe habitat species group, which this analysis associates the bighorn sheep to, would apply for the current domestic sheep grazing permitted on the Forest, as modified by the Big 6 project decision, providing it is implemented with all recommended design criteria and adaptive management strategies. This determination is that these activities **“may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing”** of bighorn sheep. The determination implies that the Devils Canyon herd would remain viable in the planning area (Forest), and would not likely experience a disease related die-off attributable to contact with domestic sheep grazing on the Forest. The design criteria and adaptive strategies are anticipated to maintain separation of domestic and bighorn sheep in the Devils Canyon area. This determination also implies that the Shell Canyon herd may not persist, and thus a loss of

individuals may occur, or possibly all individuals. This is based on the likelihood of potential contact with Forest Service permitted domestic sheep, and cumulative effects of potential contact with adjacent private land sheep, and other factors such as predation that could impact such a small population.

It is also a determination of this analysis that the viability outcomes as described in the Forest Plan FEIS for bighorn sheep are still valid and applicable, given the new information that the Devils Canyon herd now occurs on the Forest, and the Shell Canyon herd remains non-viable. Those outcomes were Outcome C for activities associated with Forest Service management, and Outcome V for cumulative activities considered (Plan FEIS, pgs. 3-96 – 99), and were given in a conservative manner to allow for uncertainty. Outcome V for cumulative effects could be arguably downgraded to Outcome III or IV, given the potential genetic exchange between the Devils Canyon and Bighorn Canyon NRA herds, however this interaction also has potential risk associated with it, and there is no linkage to populations outside this small area of Wyoming. Refer to Attachment 1 for the viability outcome definitions as displayed in the Forest Plan FEIS. It should also be noted that all populations considered in this analysis are transplanted from outside sources, and were not core, native bighorn sheep herds, indicating suitable habitat is present to sustain them, and that failures in the past have not precluded additional transplants from occurring in the future when opportunities arise and conditions change.

Therefore, it is also determined that this analysis providing supplemental information to the Forest Plan BE is an “administrative correction” under the Council on Environmental Quality regulations, and does not constitute a significant amendment, as no changes were recommended to either the forest-wide direction or management area prescriptions. Part of this determination is based on the fact that sufficient design criteria and adaptive strategies were developed under the direction in the current Forest Plan to make a determination that the Devils Canyon herd would remain viable.

These outcomes and determinations are also based on the uncertainty associated with the potential disease transmission issue, the limitations involved with imprecise bighorn sheep trend estimates, and the complexity associated with the various disease pathogens. While other bighorn/domestic sheep analyses may have placed estimated percentages of success with a particular alternative (e.g. Payette NF), these percentages were based on a much more detailed analysis of movements and habitat due to the data available with that decision, but still involved qualitative uncertainty that the models attempted to quantify. The Bighorn NF analysis, while more qualitative due to the amount of information available, incorporated similar levels of risk and uncertainty in the analysis, with sufficient confidence surrounding the outcomes to inform managers of the likely outcomes of decisions. This analysis also demonstrates that preventing contact between domestic sheep and bighorns is complicated by cumulative factors beyond the control of the Bighorn NF. As this document has been prepared with the best available science, including the risk assessment, it also serves as the “conservation strategy” for the Bighorn NF as described in FSM 2621.2. As a conservation strategy is suggested when a sensitive species may be negatively affected, this was interpreted to mean the Shell Canyon bighorn sheep herd for this project. The conservation

of the Devils Canyon herd, in conjunction with the WGFD, sets forth the fulfillment of the measures stated for conservation strategies.

## Attachment 1

### Forest Plan FEIS Viability Outcome Definitions

- ♦ **Outcome A.** Suitable ecological conditions are broadly distributed and of high abundance across the historical range of the species within the planning area. The combination of distribution and abundance of ecological conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the species.
- ♦ **Outcome B.** Suitable ecological conditions are either broadly distributed or of high abundance across the historical range of the species within the planning area, but there are gaps where suitable ecological conditions are absent or only present in low abundance. However, the disjunct areas of suitable ecological conditions are typically large enough and close enough to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the planning area.
- ♦ **Outcome C.** Suitable ecological conditions are distributed frequently as patches and/or exist at low abundance. Gaps where suitable ecological conditions are either absent, or present in low abundance, are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in overall species range from historical within the planning area may have resulted from this isolation.
- ♦ **Outcome D.** Suitable ecological conditions are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these ecological conditions may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition within the planning area may have resulted from this isolation.
- ♦ **Outcome E.** Suitable ecological conditions are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of re-colonization of such patches. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

The following outcomes are used to describe effects to species from overall cumulative effects, including those activities not associated with Forest Service management or from time spent in habitat off of the Forest.

- ♦ **Outcome I.** The combination of environmental and population conditions provides opportunity for the species to be broadly distributed and of high abundance across its historical range within the cumulative effects analysis area. There is potential for continuous or nearly continuous intraspecific interactions at high population size.
- ♦ **Outcome II.** The combination of environmental and population conditions provide opportunity for the species to be broadly distributed and/or of high abundance across its historical range within the cumulative effects analysis area, but there are gaps where populations are potentially absent or present only in low density as a result of environmental or population conditions. However, the disjunct areas of higher potential population density are typically large enough and close enough to other subpopulations to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the cumulative effects analysis area.
- ♦ **Outcome III.** The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by patchiness and/or areas of low abundance. Gaps where the likelihood of population occurrence is low or zero are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition may have resulted from this isolation.
- ♦ **Outcome IV.** The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by areas with high potential for population isolation and/or very low potential abundance. While some of these subpopulations may be self-sustaining, gaps where the likelihood of population occurrence is low or zero are large enough that there is limited opportunity for interactions among them. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical has likely resulted from this isolation.
- ♦ **Outcome V.** The combination of environmental and population conditions restricts the potential distribution of the species, which is characterized by high levels of isolation and very low potential abundance. Gaps where the likelihood of population occurrence is low or zero are large enough there is little or no possibility of interactions, strong potential for extirpations, and little likelihood of recolonization. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

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